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SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

A SCIENCE SERVICE PUBLICATION

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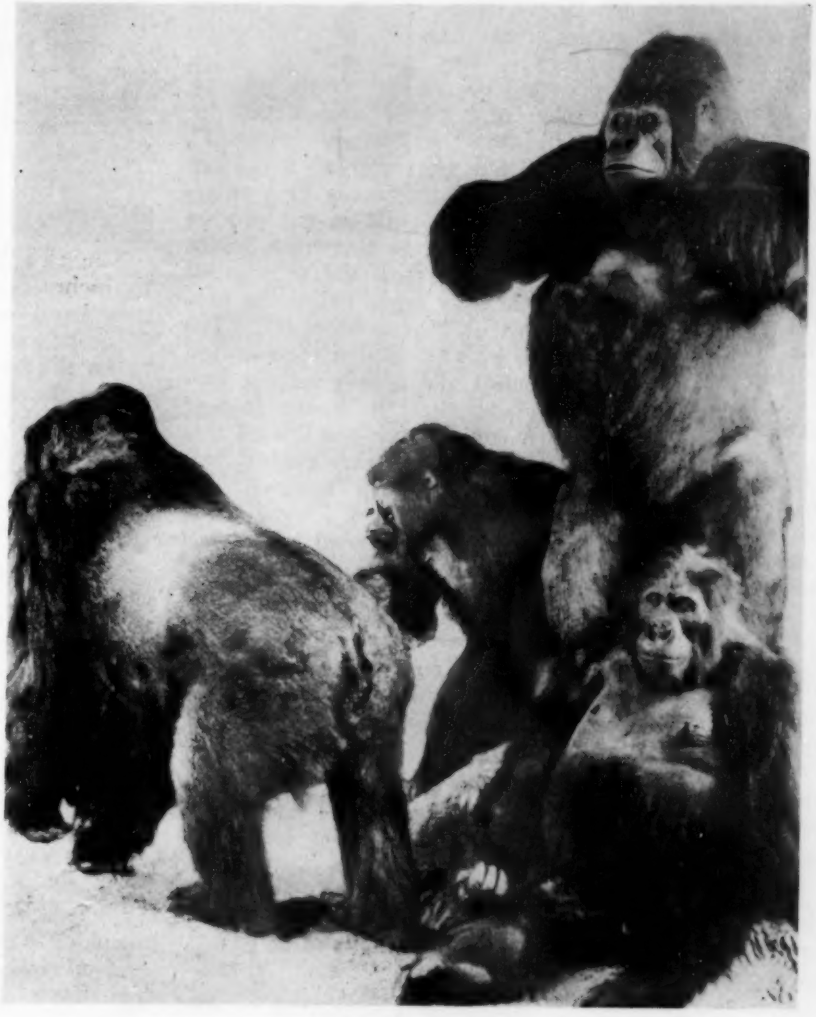

GORILLAS AT HOME

Modern Taxidermy Shows Them as Peaceful Citizens

(See page 68)

Vol. XVI No. 434

Most Powerful Vessel

Marine Engineering

The recent record trip of the German ship "Bremen" marks a new era in marine transportation and ship building. Not only is the "Bremen" the longest ship afloat, but it is also the most powerful.

When the "Lusitania" and the "Mauretania," sister ships, were built twenty-three years ago, they were designed for turbine machinery of 75,000 horsepower. This was almost double the power of any ship which had been built up to that time and it was more than double the power of any turbine engines then in existence. Yet the "Bremen" has turbine machinery of 96,000 horsepower. Prophecy was made that the "Mauretania" could not possibly withstand the vibration from such powerful engines, but must inevitably shake herself to pieces. Yet the "Mauretania" is still on the sea and last year established a new speed record. And passengers on the new "Bremen" report that the vibration was not so pronounced as to be disagreeable.

Yet the "Bremen" is only the first of a series of ships of unprecedented power promised by shipbuilders. The White Star Line is building a vessel of 60,000 tons, the "Oceanic." It is reported that this ship will be propelled by a Diesel-electric system far above the power of the largest Diesel-electric marine plant ever built. It is also reported that the Cunard Line is planning to build one or more ships even larger than the "Oceanic" which will be propelled by steam turbines up to 160,000 horsepower, more than double the power of the famous "Mauretania."

The first steamship to cross the Atlantic took 26 days for the passage. The "Bremen" crossed in less than five days. The "Oceanic" is expected to cut the record to an even shorter time.

Science News-Letter, August 3, 1929

The Maya race of old Mexico knew how to use gold and bronze, but reserved them chiefly for ornaments and used stone tools.

Bees Do Not Chew Their Food

Entomology

Bees, never having been taught correct table manners, bolt their food whole. The mandibles, formerly assumed by bee-keepers to serve as grinding instruments for "chewing" the food of the bee, were found by University of Wisconsin scientists to be in reality more comparable to our knives and forks than to our teeth. They tear off small "bites" of pollen from a large mass so that they can more easily be mixed with honey and consumed.

The whole process of digestion was made visible by feeding the bees pollen grains and honey stained different colors with harmless dyes. The two scientists, Warren Whitcomb, Jr., and H. F. Wilson, of the Agricultural Experiment Station of Wisconsin University, then followed in detail every step of the interesting process.

Pollen and honey are sucked together into the "honey stomach", which is like the crop of a chicken except that it serves only as a reservoir and does not aid in the process of digestion. From there the grains are strained out into the ventriculus by a remarkable organ called the proventriculus or "honey stopper". The observers with the aid of their optical instruments could plainly see the pollen collecting near the honey stopper and then could watch the lips of this organ separate while they pushed forward into the honey stomach and closed over the pollen. Very little, if any, of the blue-stained honey was taken with the pollen.

Immediately when it reaches the ventriculus, the pollen is surrounded by what is described as a structureless membrane and digestion at once begins. The pollen mass, with the surrounding membrane, then passes rapidly through the alimentary canal, reaching the hind intestine within two and one-half hours after it was eaten by the bee. By this time the pollen grains are nearly all empty, but the walls are still uncrushed. In some strange manner the bee is able to absorb the nourishment through the walls of the pollen grain without ever at any time masticating the grain.

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Record Bison Skull

Zoology

Yellowstone National Park has had the largest bison skull in the world for three years without suspecting it until now. It was found in 1926 by former Chief Ranger Sam Woodring, now superintendent of the new Teton National Park. Measurements recently made by a well-known firm of taxidermists indicate that it is a record head.

The two horns measure 21½ and 23 inches respectively in length, and their basal circumferences are 16 and 15¼ inches. The widest spread between the horns is 30½ inches. The largest head hitherto on record has horn lengths of 20⅞ inches on either side, with a basal circumference of 15 inches; the inside spread is the same as in the Park specimen.

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Tea Grown in Mexico

Agriculture

Common oriental tea of trade is now produced in small but commercial quantities in Mexico, according to the Ministry of Industry, Commerce and Labor.

This Mexican tea, which is of good quality, is being produced by a private planter who has been experimenting near Cuicátlan, Oaxaca, for some years. The fact that Mexico can produce this tea may become of great significance, for heretofore all tea-drinking countries have been dependent upon the Orient with its monopoly prices. *Science News-Letter, August 3, 1929*

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Radio Reception and Sun Spots

Astronomy—Physics

DR. HARLAN T. STETSON, former professor of astronomy at Harvard, who will assume the directorship of the Perkins Observatory at Delaware, Ohio, in the Fall.

By James Stokley

The present popularity of radio is largely due to the fact that there were few sun spots in 1923!

In general, radio reception is as good in summer as it is in winter!

In October of this year radio reception will probably be poorer than it has been since broadcasting came into popularity. Not until the year 1934 may we expect really good radio reception, comparable with that which we enjoyed in 1923!

These are some of the surprising conclusions to be drawn from the researches of a Harvard astronomer and a private radio engineer. Dr. Harlan T. Stetson, assistant professor of astronomy at Harvard University, is the astronomer. He has just returned from Siam, where he observed the eclipse of the sun on the ninth of May. In his absence, however, his collaborator, Dr. Greenleaf W. Pickard, a radio engineer of Newton Centre, Massachusetts, has continued the work. In fact, it was Dr. Pickard who began the researches.

In February, 1926, he began the accurate measurement of radio reception in his private laboratory at Newton Centre. Two years later a duplicate set of apparatus was installed at the Astronomical Laboratory of Harvard University, and the measurements carried on there under Dr. Stetson's direction. Some months before this, in July, 1927, Mr. Howell C. Brown of Pasadena, California, began making records of reception from San Francisco.

What these scientists are doing is to find the effect of sun spots on radio. If you watch the sun from day to day, either with the naked eye through a piece of smoked glass, or with a telescope equipped with proper eye pieces to dim the brilliant light, you will occasionally see dark spots on its surface. For the last year or two, you would have been able to see a spot nearly every day. About 1923, weeks and even months might have gone by without a spot, and the same condition will take place within a few more years.

From such observations, the astronomers have found that the number of the sun spots waxes and wanes in a regular cycle. Once in about eleven and a half years the sun spots become particularly numerous, then they decrease again. According to some astronomers we seem to have just passed the period of maximum spottedness. However, it is not possible to tell when the maximum occurred until the curve is well on the downward course. Frequently the number of spots may seem to decline and then increase again within a few months. Thus, there is expected to be an unusually large number of spots for this fall, which may prove to be the maximum.

Sun spots, astronomers have found, are really great whirlpools, or tornadoes, in the outer layers of the sun. In the view of Dr. George E. Hale, honorary director of the Mount Wilson Observatory in California, it is a huge funnel-shaped vortex. The gases travel from the inside upward and to the outside of the spot in an ascending spiral of increasing diameter. A similar motion takes place in a tornado, in which the air moves spirally upward and outward. It is just the opposite to the spiral motion of the water running out of a circular wash basin.

Gases ascend to the top of the funnel, then expand rapidly and are cooled to a temperature from 2000 degrees Centigrade or 3600 degrees Fahrenheit below the temperature of the surrounding surface. Thus, in the

DR. GREENLEAF W. PICKARD, prominent radio engineer, who started the present study of the relation of sun spots and radio reception.

words of Prof. H. N. Russell, of Princeton, "A sun spot is the greatest refrigerating mechanism known to exist", strange as it may seem to think of a temperature hotter than an arc light on the earth as "cool".

The cooling of the gases accounts for the fact that the spot is darker than the surrounding part of the solar surface, but here also the effect is due to contrast, for actually the sun spot is very bright. In fact, it is studied in the observatory by its own light. With great instruments, such as the huge tower telescope in the Mount Wilson Observatory, an image of the sun eighteen inches in diameter is obtained, and the spot is allowed to fall upon the slit of the spectroscope which analyzes its light. The light from the spot alone is sufficient to pass through the prisms and then spread out into the spectrum to leave a record of itself on the photographic plate. It is from such spectrum photographs of these spots that most of the astronomers' knowledge of their character has been learned.

There is no question that the sun spots have some influence on the earth. Great displays of the aurora borealis, or "northern lights", frequently accom- (*Turn to next page*)

Sun-Spots and Radio Reception—*Continued*

pany the passage of a large spot across the face of the sun. When average temperatures of the earth are charted over a long period, together with the numbers of sun spots, it is found that the earth is much cooler at the time of the greatest number of spots. It is warmer than average when the spots are at a minimum.

In many ways a sun spot is like the cathode ray tube developed a few years ago by Dr. W. D. Coolidge of the General Electric Company's Research Laboratory. Cathode rays, which have been known for many years, are streams of rapidly moving electrons, the minute particles of which atoms of matter are made. Before Dr. Coolidge's invention, they could only be observed in large quantities inside a vacuum tube. His tube, however, permitted the scientist to obtain them as a copious beam in the open air.

In a sense, the sun spot is such a cathode ray tube. From it comes a beam of these rapidly moving electrons, and sometimes the beam is so powerful that it bridges the 93,000,000 miles that separates the sun from the earth. When a beam of electrons enters a highly rarefied gas, the gas is ionized. An ionized atom, or "ion", is one from which one of the electrons has been removed. When such an electron is removed, the atom has a positive electrical charge. The electrons from the sun, penetrating the rarefied gases in the upper atmosphere, ionize them and make them luminous. This effect is the aurora borealis.

The path of the beam of electrons is determined also by the magnetic field of the earth. But a stream of rapidly moving electrons presents many of the characteristics of an electric current, and is therefore accompanied by its own magnetic field. The interaction of the two fields, those of the beam and the earth itself, produces magnetic disturbances which are known as magnetic storms.

These effects of the sun on the earth have been known for a long time, and it was in the year 1908 that Prof. R. A. Fessenden, one of the pioneer radio engineers, studied the relations of magnetic disturbance and radio reception at night. He found that the signals were weakened when the magnetism was disturbed. The work of Dr. Pickard and Dr. Stetson represents a modern continuation of the work of Mr. Fessenden. Dr. Stetson has described the work.

"Every night shortly before 9 p. m. Eastern Standard Time, Sundays and holidays included," said Dr. Stetson, "down in a small secluded room in the basement of the Harvard Astronomical Laboratory an attendant tunes in on WBBM, Chicago, at 760 kilocycles. Not trusting his own impressions as to whether reception is excellent, good, fair, or poor, he closes the key to the automatic recorder, whose slender pen with an impersonal but almost uncanny intelligence writes a continuous record of the intensity of the incoming waves. It is with almost cruel accuracy and utter disregard for astronomical or electrical theories that it leaves its unprejudiced and indelible record of what happens for the scientist to analyze.

"In addition to the measurement of radio reception the sun is photographed at the Harvard Laboratory every clear day in cooperation with the Yerkes, Mount Wilson, and Naval Observatories, and a careful study made of the size, numbers and locations of the sun spots each day. It is believed from a preliminary study that the distance of the spots from the center of the disk, or the sun-earth line, is an important factor in the study of correlation of sun spots with radio reception and other electro-magnetic phenomena on the earth.

"It is in the reduction and analysis of these records that the startling discovery of the effect of sun spots on radio has become established.

"The apparatus employed is a super-heterodyne receiver especially constructed for the purpose and feeding into a self-recording galvanometer which registers in microvolts in the antenna the strength of the carrier wave received from the broadcasting station of WBBM, Chicago. The apparatus is so designed that the modulations of the carrier wave do not affect the record appreciably, and the results obtained are independent of the nature of the program broadcast.

"Realizing the importance of the investigation, the broadcasting station scrupulously maintains a constant energy output in its antenna current, and each night before the Harvard Laboratory begins work the receiving set is carefully calibrated by means of a small local oscillator in the laboratory placed in close proximity to the receiving set. The output of the local oscillator necessary to maintain full scale deflection upon the galvanometer of the receiver is then read from a microammeter in circuit and the constant of the apparatus for the evening is thus determined.

"In this way local sources of error both at the broadcasting and receiving ends are eliminated and the resulting measures of the variable reception from night to night may be attributed to the changing electrical conditions of the atmosphere through which the broadcasted wave travels en route from Chicago to Cambridge.

"Scientists differ in their ideas as to just what happens when a broadcasted wave travels over the earth. Some believe that an ether wave is propagated which is reflected back to earth from an ionized layer of the earth's atmosphere known as the Kennelly-Heaviside layer which lies some 70 kilometers above the earth's surface. Others maintain that the electric wave is refracted rather than reflected from such a layer.

"Whatever the mechanism, the wave appears to be turned back by this ionized layer of the earth's atmosphere. Any change in the intensity or degree of this ionization or electrification of the earth's upper atmosphere would have the effect of bending the ray more abruptly or less abruptly towards the earth and would at once be noticed in the intensity of radio reception. The more rapid changes of this sort are doubtless responsible for the phenomena of fading with which every radio fan is thoroughly familiar.

"According to our theory, the sun constantly bombards the earth's atmosphere with electrons or bundles of energy of high frequency which, in turn, tear apart the positive and negative charges of the atmospheric molecules. In other words, they ionize the atmosphere to a very considerable extent, thus producing the Kennelly-Heaviside layer. If the sun is more active on occasions, as when large spots appear on its surface, the degree of ionization increases, producing substantially the effect of lowering the Kennelly-Heaviside layer and upsetting the radio reception. When the sun is again less active, the atmosphere tends to return to its normal state of ionization and radio broadcasting reception tends to improve as the ionized layer lifts.

"For certain wave lengths it is possible that the effect of a rising and falling ionized layer might actually be the reverse of that noted in the broadcasting zone, giving improved reception during (*Turn to next page*)

Sun-Spots and Radio Reception—*Continued*

greater solar activity and poorer reception during less solar activity. Curiously enough, this is just what has been observed by Dr. Pickard at the Newton Centre Laboratory when working on long waves of 18 kilocycle frequency."

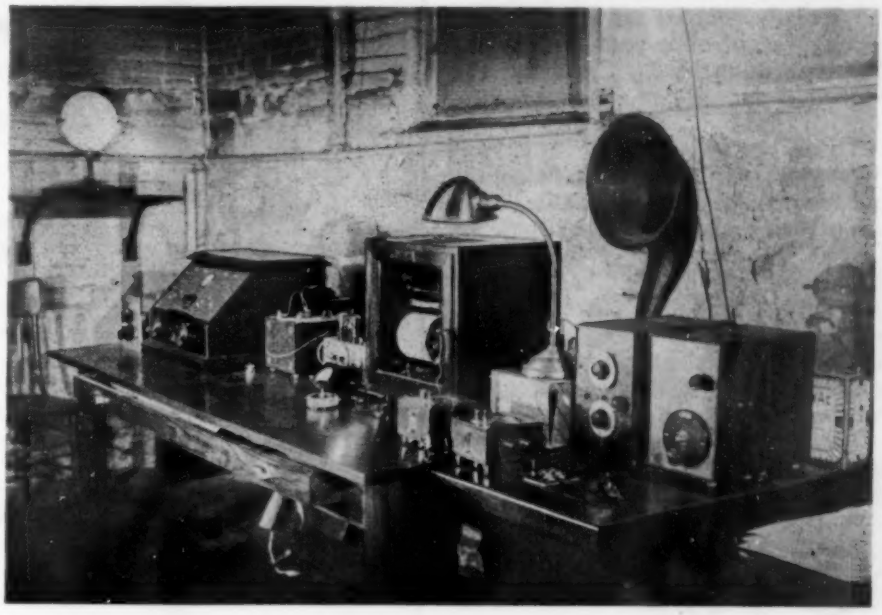
Not only is there a difference due to wave-length, but the direction that the radio waves travel is also a factor. There is a further difference between day and night.

"In announcing my results previously, I have emphasized the fact that the reception considered is at night, and now I will add the further qualification of West-East transmission path," said Dr. Pickard the other day. "For day reception, which Dr. Austin has been measuring at Washington since 1915, is in general inversely related to night reception, so that associated with high sunspot number and disturbances of terrestrial magnetism we find high values of day reception and low values of night reception. And, principally through the records taken by Mr. Brown at Pasadena over a more nearly north-south path, I am finding that night reception along a meridian obeys a different law. Owing to the shortness of this Pacific Coast series, I cannot at present give its relations to solar activity and other elements, although apparently it also follows a monthly cycle."

If the curve showing the number of sun spots is charted on a sheet of paper and the curve for radio reception is charted underneath it, it is found that there is a striking similarity. As the number of sun spots goes down, the radio reception goes up and a time of many sun spots is closely associated with a time of poor reception. Another striking feature of the curve is that it is quite regular. In about fifteen months the sun spots come to a maximum and then decrease.

In January, 1926, the spots were unusually numerous, and radio reception was poor. By August of the same year the spots had considerably decreased and radio reception had considerably improved. April, 1927, brought even more sun spots than January of the previous year, and even poorer reception. Then the spots declined and reception rose until the fall of 1927 had few spots and good reception. By July, 1928, there were even more spots than on the two previous occasions and even poorer reception.

The times of these maxima are about fifteen months apart, and so this autumn, probably about October, there should be another maximum number of sun spots and another time of poor reception. Dr. Stetson and Mr. Pickard both believe that the spots will be even more numerous than they have been in the past three occasions and that reception will be even poorer. Not until 1934, when spots are again at their minimum, will our radio reception become especially good.



APPARATUS FOR MEASURING RADIO RECEPTION, designed by Dr. Pickard and installed at the Harvard Astronomical Laboratory

It is a striking thing, brought out by this work, that in 1923 the sun spots were also at their minimum. Though at that time such careful observations were not made on radio reception, it is known that during that year conditions were unusually good. As this was the time when radio broadcasting was just coming into popularity, the good reception associated with the few sun spots contributed to a large extent to its present popularity.

Another favorite idea that is contradicted by Dr. Stetson's and Mr. Pickard's work is the belief in a difference between summer and winter radio reception.

"An important result of the study of the reception curve is to show how completely unfounded is the popular impression that radio reception is universally poor in summer and good in winter," said Dr. Stetson. "Generally speaking, reception should be better in the winter months on account of the shortened days and decreased daylight. On the other hand, the sun spots and radio curves of 1926-28 show that the increased solar activity actually gave much poorer reception in the winter months of both 1926 and 1927 than during the summers of the same years."

While this work shows undoubtedly the relation between the sun spots and radio reception, the experimenters are both of the opinion that the relation is probably not one of cause and effect.

"It seems far more plausible that changes in solar activity are more directly responsible for variations in the signal strengths received than that such should be dependent upon any absolute values in atmospheric temperature," they say.

But the knowledge thus gained of the nature of the gravity of the sun itself may prove to be the most important outcome of these researches.

"That the earth is in the midst of an immense electric field emanating from the sun and varying with the solar cycle may prove to be the outcome of our investigations," said Dr. Stetson. "For many generations scientists have recognized a recurrent cycle in solar activity, but never before now has it been possible to study the changing degree of the electrification of the earth's atmosphere with the coming and going of sun spots across the solar disk. All this has come about by the development of radio."

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New Aztec Idols

Archaeology

Tenayuca, the Aztec ruin which has already yielded so many interesting objects of a past civilization that it is undoubtedly the most important Aztec site in Mexico today, recently gave up three more idols of stone.

Two are sitting on their haunches and have their hands on their knees while their heads bear ornate headdresses. A third idol is just a face broken off a body that has not yet been found. All three represent priests or gods, who may be identified later when their adornments are studied. The style of carving is Aztec.

The site of Tenayuca has yielded an enormous quantity of pottery, whole and in fragments, which has been classified and is being studied by Eduardo Noguera of the Direction of Archaeology of the Mexican Ministry of Education. Some stratigraphic explorations have been made to determine the succession of cultures that have existed in that region. Pottery fragments belonging to the Archaic, Toltec and Aztec periods have been found, and objects from the oldest of these periods, the so-called Archaic, have been found to an unusual depth, indicating that Tenayuca has been occupied continuously for very long periods of time.

A combined study of the architecture of the pyramid, the story the pottery fragments tell, and the numerous hieroglyphs carved on the pyramid stairway and at other places, is now being made by Mexican government archaeologists.

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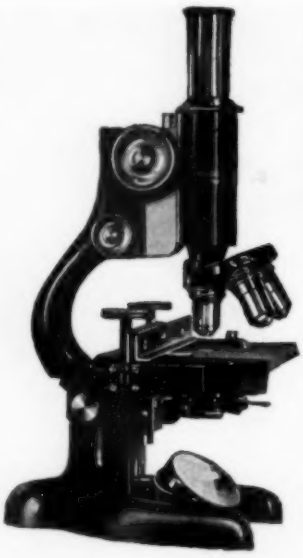

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Urges Mineral Control for Peace

Mineralogy

A scientific proposal for real "teeth" to make the Kellogg treaty effective through a U. S.-British control of the mineral supplies of the world was laid before the meeting of the British Association for the Advancement of Science at Johannesburg. In his presidential address, Sir Thomas Holland, Rector of the Imperial College of Science, London, proposed an amendment to the resolution offered by Senator Capper of Kansas, rendering even more stringent the embargo proposed by the American statesman against violators of the terms of the treaty.

In Sir Thomas' opinion, Senator Capper's suggestion that war munitions be placed on the forbidden list does not go far enough. He said, in part:

"Those of us who had the painful duty of deciding between civil and military necessities in the Great War, know well that there is now but little real difference between the materials required to maintain an army on a war footing and those that are essential to the necessary activities of the civilian population; *materials* essential for one purpose can be converted to *articles* required for the other. Thus, if Senator Capper's resolution be adopted by those who have signed the Kellogg Treaty, either sympathy for the civil population would be stirred, or the armies would be still supplied with many essential munitions: the definition of 'conditional contraband' would still remain as a cause for international friction.

"A formula, still simpler but equally effective, is indicated by this review of the new situation arising from the essential use of minerals. It is suggested, therefore, as an amendment to Senator Capper's resolution, that the simple words 'mineral products' be substituted for 'arms, munitions, implements of war or other articles for use in war.'

"The only two nations that can fight for long on their own natural resources are the British Empire and the United States. If they agree in refusing to export mineral products to those countries that infringe the Kellogg Pact, no war can last very long. As our friends across the Atlantic have recently learned, it is easier to stop exports than to prevent imports: the Customs' officer is more effective, less expensive and far less dangerous than a blockading fleet."

This possibility of U. S.-British cooperation to deny to warlike nations the means of working their warlike will, Sir Thomas said, is due more to coincidence than design. When the nations of the world were working out their present outlines on the map, agricultural areas were about all their statesmen and kings thought about. Mineral resources were considered only incidentally, because metalliferous ores and other minerals figured only as incidentals in the lives of the people. They were worked only on a small scale and by relatively primitive methods.

But with the coming of the industrial revolution, minerals began to play an ever-increasing part in human welfare; until the first quarter of the twentieth century saw more minerals used than had been consumed in all the history of the world before that time. No nation is independent in a mineral sense, not even the British Empire or the United States, nor even both of them together. But between them they control more than nine-tenths of the mineral resources of the world, and by agreeing on peace they are in a position to bring powerful pressure to bear on other nations, without either making or threatening war upon anyone.

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Matter Between Stars

Astronomy

Space between the stars is not the empty nothingness that has previously been supposed. Great clouds of calcium and sodium, elements present on the earth in lime and table salt respectively, are in interstellar space and make their presence known by the way they affect the star light passing through them.

At the meeting of the section on physics and astronomy of the British Association for the Advancement of Science, Prof. A. S. Eddington, eminent astronomer of Cambridge University, discussed the problems connected with these cosmic clouds.

When the light from a star enters a telescope and is analyzed by the prisms of a spectroscope, dark bands are obtained that show the elements present in the star. If the star is approaching or receding from the earth, the lines are displaced one way or the other. But sometimes lines of sodium and calcium appear which are in the same position without regard to the star's motion. These are due to clouds of these elements through which the star's light passes on its way to the earth. As these lines may appear in the spectra of all the stars from a certain region of the sky, the extent of the clouds may be gauged. They only appear in connection with the more distant stars, hundreds of light years away, and so the distance of the nearest of them can be roughly determined.

By a theoretical study of such diffuse clouds, Professor Eddington has found that they would absorb enough of even the feeble radiation from the stars to raise them to a temperature nearly as hot as the stars themselves —perhaps 15,000 degrees Centigrade. Professor Eddington has also calculated their probable density and finds them extremely rarefied. A one followed by 24 ciphers represents the number of times that they would have to be condensed to be of the same density as ordinary air, he believes. Such a density would account for spectrum lines of the strength observed.

Science News-Letter, August 3, 1929

Diet Allays Pain

Medicine

A diet which will prolong life and relieve pain somewhat in patients suffering from certain types of cancer was reported by Dr. S. Monckton Copeman to the British Association for the Advancement of Science. The dietary measures can only be adopted when the disease does not interfere with normal eating.

The diet restricts as far as possible the eating of foods rich in fat-soluble vitamins of animal origin, such as meat other than pork, as well as eggs, butter and cream. The necessary vitamins are obtained mainly from fruit and vegetables, especially water cress. However, Dr. Copeman emphasized that the diet is by no means strictly vegetarian, as white fish of all kinds are allowed.

Some patients put on this diet actually gained in weight, Dr. Copeman reported. The treatment is especially helpful after operation, with the object of preventing, if possible, recurrence of the disease, he said.

Science News-Letter, August 3, 1929

Archaeological Mine in South Africa

Archaeology

South Africa's unlimited wealth in prehistoric relics is an asset of great value, worthy to be ranked with its famous wealth in gold and diamonds, Henry Balfour, of Oxford, told the British Association for the Advancement of Science at its session at Johannesburg.

The quantity of prehistoric material deposited in the vast African area south of Zambesi is probably due to the successive waves of immigrants who arrived in early times from the north, he pointed out. South Africa was a cul de sac, which arrested any further southward dispersal; so here they stayed. Contacts and clashes between groups tended to result not only in fusion but also in confusion, and to bring about complex hybrid conditions which local archaeologists must now struggle to unravel.

Failure of scientists to study the Bushmen of South Africa before they dwindled and before their striking culture traits became obscured was deplored by the speaker, who said that these Africans were literally Stone Age men who survived into modern times and who might have made clear many of the obscure points as to the life of the prehistoric Old Stone Age.

The functions of the old implements used by Stone Age men in Europe have been diagnosed as far as possible, and the stone objects are known as axes, scrapers, gravers, and by other terms that indicate their presumed uses. But this is largely guesswork, Mr. Balfour said. Had the living users of identical types of tools been closely studied we might know more certainly the uses and details of manufacture employed in prehistoric times.

Paintings left on the rocks by Bushmen artists could perhaps have been observed in the making and their true meaning understood if science had been sooner alert to the significance of this art. As it is, experts can only pore over the grotestque paintings of men and animals and attempt to interpret the art ideas of primitive man.

Science News-Letter, August 3, 1929

Drugs No Help for Flowers

Botany

Don't put your cut flowers in a bath of aspirin or other chemicals in an effort to prolong their life. Experiments conducted at the Boyce Thompson Institute for Plant Research showed that none of 50 different chemicals, used in the hope of increasing the life of cut flowers, was noticeably effective. Potassium permanganate did prevent decay of the stems of phlox and asters but it did not make the floral parts last any longer. Other chemicals in some cases actually caused injury to the flowers.

Low temperatures were a great help in keeping roses, carnations, and coreopsis, but the cold did not greatly benefit either cosmos or dahlias. Humidity is also an important factor in keeping cut flowers. Carnations kept two to three times as long in an atmosphere which was nearly saturated with moisture.

Science News-Letter, August 3, 1929

The impossibility of dividing by zero was first proved by the mathematician Martin Ohm, in 1828.

Possible to Tune Bells

Physics

A church bell made from the finest bell metal may give forth a harsh, unpleasing sound, due to the fact that it is out of tune with itself. The stroke of a single bell sounds to us like one note, and until very recently even the most expert bell makers have not realized that the sound is really made up of five separate notes. The five notes must be in tune with one another in order that the bell may give forth a harmonious sound. What we then hear is a combination of what is known as the strike note, the nominal, which is an octave above the strike note, the hum, which is an octave below, and the third and fifth.

This recent discovery regarding the harmonics of bells has made possible the new art of bell tuning, a revival of what for two centuries was considered a lost art. The large bells are inverted on a huge turntable and revolve while the metal is pared away from the inside until it is correctly shaped to produce the harmonious tones.

Science News-Letter, August 3, 1929

Some of the wells drilled in rock salt deposits in China in order to pump up the brine are as deep as 3,000 feet.

Rocks Tell Story of Plant Evolution

Paleontology

Botanists in attendance at the meetings of the British Association for the Advancement of Science were taken on a botanizing excursion further back into time than they have journeyed in space to reach South Africa. Prof. A. C. Seward of Oxford University, one of the world's foremost authorities on fossil plants, led them on a journey through the weird forests that once throve in the southern hemisphere, in his address on "Botanical Records of the Rocks."

After the lush days of the Coal Age, millions of years ago, there came a time of meager opportunity and pinched living for plants of the northern hemisphere, during the age known to geologists as the Permian. At the same time there existed to the south a vast continent, connecting what are now separate land masses of Africa, Australia and South America; this is now called "Gondwanaland." On this continent, separated from the northern lands by a broad sea, a new and progressive world of plants evolved, some of whose descendants later migrated northward and settled in the northern hemisphere.

It was not exactly a paradise for vegetable existence that these plants found in Gondwanaland, however. Professor Seward pointed out to his audience that there are many evidences that in this remote time, millions of years before the period we usually call the Great Ice Age, there was another Ice Age, during which glaciers crept northward from the austral borders of the land, and then gradually retreated, followed as they went by the pioneers of the plant world.

In closing, Professor Seward disagreed with the widely accepted idea that the presence of warm and temperate-climate plant fossils in arctic regions necessarily indicated a very great difference in climate between ancient times and the present. A rearrangement of land mases, permitting ocean currents to flow where they are now barred and preventing the year-by-year accumulation of snow that turns to ice, could very well permit a much more temperate-climate type of vegetation in high latitudes without violent changes in the climate itself.

Science News-Letter, August 3, 1929

Barns are popularly painted red because oxide of iron paint, which is cheap and durable can be obtained in red color only.

8% of Empire Cultivated

Agriculture

Although the British flag now flies over nearly a fourth of all the land area of the world, inhabited by nearly a fourth of all living human beings, only a fraction of all that area is now under cultivation, Sir Robert B. Grieg, Chairman of the Board of Agriculture for Scotland, informed his fellow agricultural scientists at the Johannesburg meeting of the British Association for the Advancement of Science.

"Of this immense area no precise measure of the full extent of land in agricultural use is available, but the proportion is small," Sir Robert said, in part. "The most intensively cultivated of the larger areas is India, the least intensively cultivated is Australia. In the aggregate only 8.7 per cent. of the total land surface of Canada, India, the Union of South Africa, Australia, and New Zealand is under arable cultivation. Only about one acre in every hundred of Australia is under cultivated crops, about two and a half acres in Canada, and three acres in South Africa and New Zealand respectively. It is difficult to obtain figures indicative of the possibilities of the tropical and sub-tropical territories, but the African possessions alone are capable of enormously increased production.

"In the nine provinces of Canada, the 'possible farmland' is 358 million acres, or about one-quarter of the total land area of the provinces, and five and a half times the present total of both arable and pasture. In India, the most intensively cultivated, it is estimated that the cultivable waste land is equal to half the present cultivated area, or about 153 million acres."

The speaker outlined a comprehensive scheme for a scientific development of agriculture throughout the empire. Agencies exist, he said, or can be called into existence easily, for mapping the campaign and financing it. The Dominions can supply and train their own technical workers, but the less developed colonies must still depend on the homeland for their personnel.

Science News-Letter, August 3, 1929

The alligator pear has a higher food value in calories than any other fresh fruit except the olive.

The average speed of automobile driving in Massachusetts has increased ten miles an hour in the past ten years.

New Television Station Opened

Radiovision

To the thousands of amateur television fans equipped with apparatus for picking pictures and movies out of the ether there will probably be added many more in the near future. Station W3XK, of the Jenkins Laboratory, is now being operated with new equipment and increased power. Up to the present this station has been using 250 watts in the transmitter at the Washington laboratory. The new station, in one of the suburbs of Washington, uses 1500 kilowatts at present. The Radio Commission has approved a power of 5000 watts.

Radiomovies are now being broadcast every night from the station between the hours of 8 and 9 p. m., Eastern Standard Time. One room has been provided at the new station for a television studio, from which broadcasts of living subjects will be made, when the equipment is completed.

Airplane television broadcasts will be attempted from the new station before long, according to Dr. C. Francis Jenkins. He has just received a new Stinson airplane from the factory and is equipping it with a television camera which will operate through a hole in the floor of the cabin. The scene will be transmitted by radio to the station on the ground, where it will be picked up and rebroadcast with greater power.

Science News-Letter, August 3, 1929

WHAT TO SEE BY RADIO

STATIONS ON REGULAR SCHEDULE

CHICAGO, ILL., W9XAA, Chicago Federation of Labor, 500 watts (approved for 1000 watts), 2000-2100 kc. or 145 m. 48x48xx15.* 9:00 to 11:00 a. m. Central Standard Time, daily except Sunday; movies, still pictures and living subjects.

JERSEY CITY, N. J., W2XCR, Jenkins Television Corporation, 5000 watts, 2000-2200 kc. or 139 m. 48x48x15. 2 to 3 p. m. Eastern Standard Time, daily except Saturday and Sunday and 8 to 9 p. m. Monday, Wednesday and Friday.

LEXINGTON, MASS., W1XAY, Lexington Air Station, 500 watts (construction permit granted for 5000 watts), 2000-2100 kc. or 145 m. 48x48x15. Daily, 3 to 4 p. m. and Friday 7:30 to 8 p. m.

MT. BEACON, BEACON, N. Y., W2XBU, Harold E. Smith, 100 watts, 2000-2100 kc. or 145 m. 24x24x20. Transmits television programs, generally living subjects, daily 1 to 2 p. m. Eastern Standard Time.

NEW YORK, N, Y., W2XBS, Radio Corporation of America, 250 watts (approved for 5000 watts), 2000-2100 kc. or 145 m. 60x72x20. Announcement cards, views and living subjects. Daily (including Sunday), 6 to 10 p. m. Eastern Standard Time.

PITTSBURGH, PA., W8XAV, Westinghouse Electric and Manufacturing Co., 20,000 watts, 2000-2100 kc. or 145 m., 2100-2200 kc. or 139 m. and 2750-2850 kc. or 107 m. 60x72x20. Transmitting television programs, generally motion picture films, Monday, Wednesday and Friday, 5:10 to 6 p. m., Eastern Standard Time.

SCHENECTADY, N. Y., W2XCW, General Electric Co., 20,000 watts, 2100-2200 kc. or 139 m. 24x24x20. Sunday 10:45 to 11:15 p. m., Tuesday, 12 to 12:30 p. m., Tuesday, Wednesday and Friday, 1:30 to 2 p. m., Eastern Standard Time.

WASHINGTON, D. C., W3XK, C. Francis Jenkins, 1500 watts, 2000-2100 kc. or 145 m. and 2850-2950 kc. or 103 m. 48x48x15. Daily 8 to 9 p. m., Eastern Standard Time, Radiomovies.

ON IRREGULAR EXPERIMENTAL SCHEDULE OR UNDER CONSTRUCTION

BROOKLYN, N. Y., W2XCL, Pilot Electric Co., 250 watts, 2000-2100 kc. or 145 m. and 2750-2850 kc. or 107 m. Construction permit.

CHICAGO, ILL., W9XAG, Aeroproducts, Inc., 5000 watts, 2100-2200 kc. or 139 m. Construction permit.

CHICAGO, ILL., W9XR, Great Lakes Broadcasting Co., 500 watts, 2850-2950 kc. or 103 m. 24x24x15.

NEWARK, N. J., W2XBA, WAAM, Inc., 50 watts, 2750-2850 kc. or 107 m.

NEW YORK, N. Y., W2XCP, Freed Eisemann Radio Corp., 2000 watts, 2000-2100 kc. or 145 m. and 2850-2950 kc. or 103 m.

OAKLAND, CALIF., W6XN, General Electric Co., 10,000 watts, 2000-2100 kc. or 145 m.

SPRINGFIELD, MASS., W1XAE, Westinghouse Electric and Manufacturing Co., 20,000 watts, 2000-2100 kc. or 145 m.

WINTER PARK, FLA., W4XE, William Justis Lee, 2000 watts, 2000-2100 kc. or 145 m.

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*Dimensions of the transmitted picture are given as follows: Number of scanning lines in height of picture; breadth of picture in line-widths; number of frames per second. Thus, 48x48x15 means that the picture is 48 lines high, 48 lines broad and 15 frames are transmitted per second. All scanning is from left to right in each line and with successive lines from top to bottom, as one reads the pages of an English book.

Nature Ramblings

By Frank Thone

Osage Orange

The generation that was young before barbed-wire and woven-wire fences became common in the country will be much better acquainted with the osage orange than the present-day youth, though the latter, in their wider-ranging motor-cars, can still find osage hedges. But before the coming of the persuasive barbed-wire salesman, the farmer who wanted to put a good, tight fence around his field would think first of this quick-growing, tough shrub, with its bristling armature of sharp thorns. In a few years the hedge would be fifteen or twenty feet high, and then he would hack it off to breast height, and the tops, after drying, would make a bonfire worth crossing half a township to see. But the hedge had the drawback of "robbing the land" for twenty feet or more on either side, so that when better artificial fences became available progressive farmers had their hedges grubbed out.

It is to be hoped that landowners generally will keep at least a few specimens of osage orange going, if only for sentiment's sake. By a little judicious pruning, the plant can be induced to grow into a rather shapely small tree, which will be ornamented in late summer with the great golden globes—quite inedible and reputed to be poisonous—that give the species its name. What man is there who was a country or suburban boy twenty or thirty years ago, that does not recall what a magnificent splash these false oranges made when you slammed them against a tree trunk or a barn door?

Curiously enough, although the osage orange is strictly American, with its center of distribution in the Ozark mountain country, its nearest relative is the famous breadfruit tree of the South Seas.

Evolution Makes Facts Fit

Evolution

Evolution was re-asserted as the fundamental faith of present-day biology by Prof. D. M. S. Watson of University College, London, in his presidential address before the section of zoology of the British Association for the Advancement of Science.

"Evolution is accepted by zoologists not because it has been observed to occur or is supported by logically coherent arguments, but because it does fit all the facts of taxonomy, of paleontology, and of geographical distribution, and because no alternative explanation is credible," Prof. Watson declared.

"But while the fact of evolution is accepted by every biologist the mode in which it has occurred and the mechanism by which it has been brought about are still disputable."

Adaptation, or the structural changes brought about to meet functional needs was the chief topic of Prof. Watson's address. The pioneer evolutionists, Lamarck and Darwin, made much of adaptation, and cited numerous well-studied cases in support of their respective theories. But the present generation of biologists has a tendency to assume a given structure or organ to be adaptive and to build on the basis of that assumption, which subsequent study may prove to be incorrect.

The Scientific Medical

Medicine

Thomas Stephenson in *The Prescriber*, reprinted in the *Journal of Industrial and Engineering Chemistry*

(With apologies to the shade of W. S. Gilbert)

I am the very model of the Scientific Medical,
I know each nerve and artery, each ligament and pedicle;
My knowledge has been built by evolutionary processes
From Galen and Hippocrates to present-day Colossuses.
I've studied all the endocrines and know the various offices
Of pancreas and thyroid, or of thymus and hypophysis;
I know the suprarenals too, and all that they're related to—
(—lated to, —lated to—ah!)
How benighted were the medicos who lived in 1882.

I know the pH value of ionical acidity;
I calculate percentages with wonderful rapidity;
And when it comes to artery or ligament or pedicle
I am the very model of a scientific medical.
I'm particularly expert at a Wassermann analysis;
I hunt for protozoa in a patient with paralysis;
The chemistry of insulin's a subject that I revel in,
And antitoxin therapy I'm just the very devil in.
I know the role of calcium in various forms of tetany;
I understand trypanosomes, although I've never met any;
And I've the latest news on perineural sympathectomy—
(— pathectomy — ectomy — ah, I have it!)
My knowledge often bringing in a good substantial cheque to me!

I'm very strong on vitamins and matters dietetical;
I know the graphic formulae of remedies synthetical;
And when it comes to artery or ligament or pedicle
I'm just the very pattern of a scientific medical.

(More slowly)
When I've acquired some knowledge about matters pharmaceutical,
When I can diagnose a little deeper than the cuticle,
When simple indigestion has become a trifle clear to me,
When babies with the colic are no more a source of fear to me,
When I can write a recipe with ord'nary galenicals,
When I have learned the doses of the various arsenicals,
When highbrow scientific lore no longer needs a missioner—
(missioner—condi- —practi- —I've got it!)
You'll then consult me safely as a general practitioner!

For my scientific knowledge, though I'm always up to date with it,
Has kept me back in practice, and I'm just a little late with it;
But when it comes to artery or ligament or pedicle
You'll find I'm just the model of a scientific medical.

Amateurs Watch for Meteors

Astronomy

With the coming of August, thousands of amateur astronomers in all parts of the United States are watching the night skies for meteors, or shooting stars. By making careful records of what they see, without the aid of telescopes or even opera glasses, they are gathering data that will enable scientists to learn more of the behavior of these celestial visitors. For meteor observation is one branch of astronomy that does not require an observatory. A pair of reasonably keen eyes, a willingness to sit up a good part of the night, and a clear, dark sky are the only essentials.

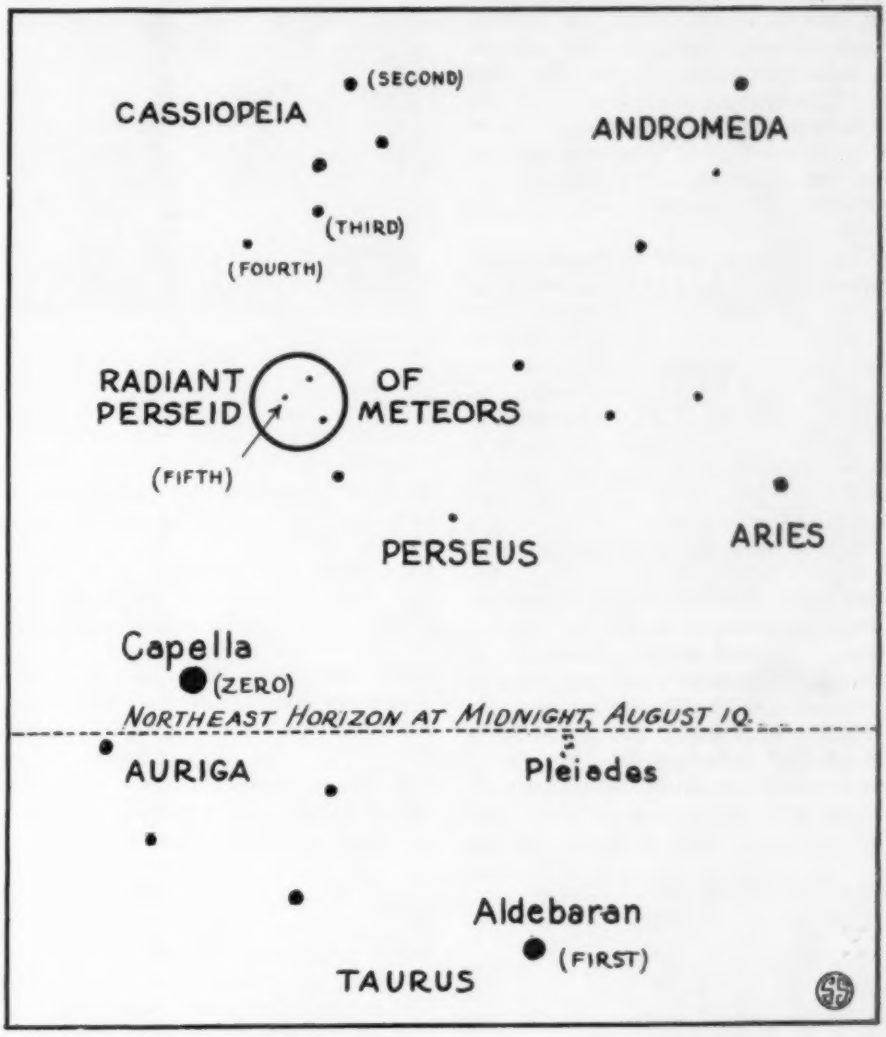
Meteor gazing is a sport that requires late hours, for the earth turns in such a way that after midnight we meet the meteors coming towards us, while before midnight they have to catch up with us. The result is that from 1:00 to 4:00 a. m. are the best hours for the chase.

Even in the earlier hours during August, if a person gets away from the brilliant lights of a large city and watches the sky, several meteors will probably be seen in the course of an hour. And after midnight a dozen or more might reward the searcher on any August night.

But on two particular nights these numbers will be enormously increased. On the nights of August 10 and 11, or really the early mornings of August 11 and 12, several hundred an hour may usually be seen. The astronomer, studying meteors, wants to know two facts about them. First of all, he wants to know their numbers, so it is a useful labor simply to count the meteors as they flash across the sky, and make half-hourly totals.

It is the paths that the shooting stars take in the sky, however, that form the astronomer's most valuable data. One way of plotting these is to have a map of the sky, and, with the aid of a small flashlight to mark down the paths with a pencil. As the meteors all move through the stars in a straight line, it is only necessary to notice where the trail begins and ends, then to mark these points on the map and to connect them with the aid of a ruler. Each path should be numbered and the number, with the time that particular meteor occurred, should be listed on a separate sheet.

When the August meteors are charted in this way it is found that they do not dash about the sky at random, like members of a swarm of bees. All the straight lines drawn on the map will be seen to radiate from a very small area, a place in the constellation of Perseus. This is a group of stars that rises above the northeastern horizon about midnight at this time of year.



The reason for this curious effect is that the meteors travel in a ringed cloud around the sun. The swarm is not sharply defined, but shades off rather gradually, so that while the meteors are especially thick in the center of the swarm, they are still numerous at some distance from the center. Every summer the earth crosses this swarm. Towards the end of July we encounter the outer ones, then they become more and more numerous until the nights of the tenth and eleventh of August, when we encounter most of them. The meteors are very tiny, some no larger than a grain of sand, most no larger than a pea. They are all moving in parallel paths. When they encounter the atmosphere of the earth, the friction heats them and burns them up, causing the flash that we see. All these flashes seem to radiate from a point, just as the straight lines of a long corridor, or a railroad track, seem to come to a point in the distance.

The accompanying map shows the part of the sky from which the August meteors seem to emerge. The point from which they radiate is called the radiant, and as this radiant is in the constellation of Perseus, these meteors are called the Perseids. At midnight the horizon is approximately in the position indicated by the dotted line; a little later the constellations of Auriga, and Taurus, shown below it, rise into view. With this map you have the materials with which to do a real piece of astronomical observation.

Remember that *(Turn to next page)*

Huge Sunspot Causes Magnetic Storms

Astronomy

A sizable sunspot with extraordinary magnetic field has just passed across the sun's face. It was seen in the solar telescopes of the Mt. Wilson Observatory by Dr. Seth B. Nicholson and his associates. To it are attributed the magnetic storms of a few days ago that affected instruments in various parts of the world.

The ordinary solar magnetic field, surrounding a spot, has a value of 50 gausses, the units in which the physicist measures magnetic intensity, but the sunspot just observed has a value of 4000 at its center. The earth's magnetic field, measured in the same units, is only one-half a gauss, but ordinary magnets used in electrical work often have fields of over 10,000 gausses.

Seldom does the astromer encounter such a highly magnetic spot. Intensities of 3500 are usual. Although a greater intensity would not be unusual in a small magnet here on the earth, it is unusual when it occurs in a sunspot, such as the recent one.

This spot was 33,000 miles long and 20,000 miles wide. It was a single solar marking located about sixteen degrees to the south of the sun's equator. Two weeks from now it is likely to reappear on the sun's surface, as by that time the sun's slow rotation will have carried it completely around. Mt. Wilson astronomers say that it will again cross the sun's meridian on August 14, if it survives. Then it may again be accompanied by magnetic storms on the earth.

Sunspots occur in the surface of the sun—the layer that astronomers call the photosphere. A mass of hot gases shoots up from the interior of the sun to the surface, rapidly revolving like a bullet in a rifle barrel. As they get to the surface, a whirlpool of gases results, the pressure is reduced and they are rapidly cooled. This sudden cooling causes a reduction in brilliance, and so the spots appear dark against the more brilliant solar background. They shoot out streams of tiny electrical particles, or electrons, which may reach the earth when the spot is on the right side of the sun. These electrons, acting in conjunction with the magnetic field of the earth itself, produce such effects as the northern lights, and the magnetic storms that may tie up telegraphic communication.

Science News-Letter, August 3, 1929

Infringement of Food

Physiological Chemistry

The Wisconsin Alumni Research Foundation has filed suit against the Solar Research Corporation and the Sargent Drug Company, charging infringement of patent rights which the Foundation holds on the process of irradiating foods and medicines.

The patent rights cover the process developed by Prof. Harry Steenbock of the University of Wisconsin, by which foods and medicines may be supplied with vitamin D, or their vitamin D content increased, as a result of exposure to ultra-violet rays. This vitamin is the growth-promoting anti-rachitic factor contained in large amounts in cod liver oil and in lesser amounts in certain foods. When Prof. Steenbock found a way of making ordinary foods rich in this important vitamin, the Wisconsin Alumni Research Foundation applied for patent rights on the process, so that its benefits might be made available to the public under properly controlled conditions.

Licenses to use the patented process have been granted to some commercial companies. The proceeds from the licenses of the patent rights are used for further scientific research at the University of Wisconsin.

Science News-Letter, August 3, 1929

Gorillas at Home

Zoology

Africa, the once-thought "inexhaustible paradise of game", is going the way of the North America of the past century, and it may not be long before it will be impossible for even a Carl Akeley to assemble such a group as is depicted on the cover of this issue of the SCIENCE NEWS-LETTER. This great scientist-explorer-artist visited the gorillas, the biggest of the primates and in some ways the most manlike, in their homes in the remote fastnesses of the Congo, helped to secure the specimens, and then set them up in the American Museum of Natural History in New York.

The fashion of mounting gorillas has changed in the past few years. Formerly it was the custom to show the male animal with his lips curled back, exposing his great teeth and giving his face an expression of the utmost ferocity. Naturalists now are fairly well agreed that this was a libel committed for no better purpose than to display a fine battery of incisors and canines. Except when molested by a hunter, the gorilla is said to be a decently-behaved citizen of the jungle.

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August Meteors—*Continued*

there is no use trying to observe them from a big city, so get out into the country, away from the bright lights, and where you have a clear view of the northeastern horizon. Start observing about midnight, if it is clear. As the moon is at first quarter on the twelfth, it sets at midnight, and the sky is dark. Have a small flashlight handy to see the map, but the light had better be covered with several thicknesses of tissue paper. Otherwise its brilliant glare may temporarily blind you to a faint meteor. As soon as you see a meteor, notice its path in the sky. By holding a ruler at arm's length, parallel to the meteor's path, and sighting along it, you can do this most easily. Then, with the aid of the flashlight, draw its path on the map. Number it, and on a separate sheet note the time and brightness. You can judge its brightness as compared with nearby stars. The numbers on certain stars on the map refer to their magnitude, and provide a scale with which to judge the brightness of the meteors. If you can't chart the meteors, simply count them. On a piece of paper lay out a series of spaces, marked 12:00 to 12:30, 12:30 to 1:00, etc. Every time you see a meteor during these times make a check, then you can count up totals later.

And then, when the night is over, don't forget to send your material to Dr. Charles P. Olivier, University of Pennsylvania, Philadelphia, Pa. Tell, as accurately as possible, the location from which you observed the meteors. Professor Olivier is president of the American Meteor Society and operates a clearing house for information concerning them, and your data will help his studies.

Science News-Letter, August 3, 1929

Death Rate Increases

Sociology

Latest figures from the U. S. Bureau of Census show an increase in the death rate for the registration area of the country, exclusive of Massachusetts and Utah. At the same time the birth rate fell off. The latter was 19.7 for 1928 compared with 20.7 for 1927. In the same area the death rate was 12.3 in 1928 compared with a rate of 11.4 in 1927.

Science News-Letter, August 3, 1929

CLASSICS OF SCIENCE: The Discovery of Neptune

Astronomy

The fulfillment of prophecy is both gratifying and amazing to the human mind. The discovery of the trans-Uranian planet was a very spectacular fulfillment of prophecy, in which several of the foremost astronomers and mathematicians of the world played their parts. We give here a summary of their work, rather than a quotation from any one of them.

REPORT ON THE HISTORY OF THE DISCOVERY OF NEPTUNE. By Benjamin Apthorp Gould, Jr. Washington City: Published by the Smithsonian Institution. 1850.

Motion of Uranus

The strange series of wonderful occurrences of which I am to speak is utterly unparalleled in the whole history of science;—the brilliant analysis which was the direct occasion of the search for a trans-Uranian planet,—the actual detection of an exterior planet in almost precisely the direction indicated,—the immediate and most unexpected claim to an equal share of merit in the investigation, made in behalf of a mathematician till then unknown to the scientific world,—and finally the startling discovery, that, in spite of all this, the orbit of the new planet was totally irreconcilable with those computations which had led immediately to its detection, and that, although found in the direction predicted, it was by no means in the predicted place, nor yet moving in the predicted orbit. This series of events, together with the since developed theory of Neptune, constitute the subject of my report. . . .

The planet Uranus was discovered by Sir William Herschel on the 13th of March, 1781, and, although at first supposed to be a comet, was before the end of the year recognized as one of the primary planets of our solar system. Circular elements were first computed during the summer of 1781, by Lexell, of St. Petersburg, at that time in London; and others were soon after published in Russia, France, and Germany. The computation of a planetary orbit was at that time a most laborious and troublesome process, by no means to be compared with the easy methods in use since Gauss gave to the world the elegant and simple formulas of the *"Theoria Motus."* No elliptic elements were computed, therefore, until the year 1783, during which year elliptic orbits differing but slightly from each other were published by Méchain, Laplace, Caluso, and Hennert; and in the French and German astronomical Ephemerides for 1787 (published in 1784) were tables of the new planet. . . .

THE DISK OF NEPTUNE with its satellite is at the right of the picture photographed at the Yerkes Observatory. It is seen to be appreciably larger than the star at the left.

In the mean time Bode, the Astronomer Royal of Prussia, had suggested that Uranus might have been observed by astronomers before the discovery of its planetary nature, and consequently that earlier observations might be found by a proper search in the catalogues of fixed stars. This happy idea prompted him to study over the old star-catalogues, and his search was crowned with abundant success. . . .

The best tables of Uranus which existed before the masterly and accurate researches of Le Verrier, in 1845 and 1846, were those computed by Bouvard in 1821. Bouvard was acquainted with all the ancient observations which we know, excepting three by Flamsteed in 1715. In the introduction to his tables, he announced that he had been utterly unable to find any elliptic orbit, which, combined with the perturbations by Jupiter and Saturn, would represent both the ancient and the modern observations. The best tables which he could obtain by the use of both represented neither of them, in any way at all satisfactory. On the other hand, by using modern observations only, he was enabled to find elements which, although they gave errors amounting sometimes to 74″ for the ancient observations, still satisfied all the modern ones comparatively well, —never differing more than 10″ from theory, and generally much less. . . .

He therefore summarily rejected the former observations, and founded his tables upon the latter alone, adducing arguments against the accuracy of the ancient observations, and forgetting how well they harmonized with one another, and had harmonized with the elements obtained soon after the discovery of the planet.

But a very few years after the publication of Bouvard's tables, important differences between theory and observation became again manifest, and attracted the attention of astronomers.

Airy alluded, in 1832, to these discrepancies, in his report to the British Association on the Progress of Astronomy, and mentioned that the tables, constructed only eleven years previously, were in error nearly half a minute of arc.

It is an easy thing to censure Bouvard for the readiness with which he abandoned the ancient observations,—now that we know that the discrepancies were caused by the action of an exterior planet, and that the maximum of error in the ancient observations amounted to only nine seconds. . .

Influence of an Unknown Planet

Mr. Eugene Bouvard, nephew of the author of the Tables, wrote as follows on the 6th October, 1837, from Paris, to the Astronomer Royal of England:—"My uncle has given me the tables of Uranus to reconstruct. In consulting the comparisons which you have made between observations of this planet and the calculations in the tables, it will be seen that the differences in latitude are very large, and are continually becoming larger. Does this indicate an unknown perturbation exercised upon the motions of this star by a body situated beyond? I do not know, but this is at least my uncle's idea."

Professor Airy remarked in his reply, that the error in latitude was very small;—that it was the errors in the longitude which were increasing with so fearful rapidity. And, a few months after, he showed that the tabular radius-vector of Uranus was much too small. This result of observations at the quadratures was one to which Professor Airy, both at that time and uniformly since, attached great importance.

It is from this period, that the definite belief of most astronomers in the existence of a trans-Uranian planet appears to date. Numerous mathematicians subsequently conceived the purpose of entering earnestly into laborious and precise calculations, in order to decide whether the assumption of an exterior cause of disturbance were absolutely necessary, and, if so, to determine from the known perturbations their (*Turn to next page*)

Discovery of Neptune—*Continued*

unknown cause. The Astronomer Royal most justly expresses himself "confident, that it will be found that the discovery is a consequence of what may properly be called a movement of the age; that it has been urged by the feeling of the scientific world in general, and has been nearly perfected by the collateral, but independent, labors of various persons possessing the talents or powers best suited to the different parts of the researches."

The problem became, from this time forth, one of the most important questions of Physical Astronomy. Astronomers in various countries busied themselves with it, and spoke of it without reserve. . . .

The next letter of Mr. Adams, which has been printed, is dated September 2, 1846. Le Verrier had, in the mean time, not only published the memoir already alluded to, in which the perturbations of Uranus by Jupiter and Saturn are fully developed, calculated, and discussed,—but had communicated to the Academy two other most important papers. In one, presented on June 1st, 1846, he proved that the motions of Uranus could not be accounted for, except by introducing the perturbative influence of an unknown planet, for which he assigned an approximate place. In the other, he found an orbit, a mass, and a more precise position for the disturbing planet. This was presented on the 31st August.

Mr. Airy mentions, that on the 29th June, at a meeting of the Board of Visitors of the Greenwich Observatory, at which Sir John Herschel and Profesor Challis were present, he spoke of the extreme probability that another planet would be discovered within a short time; and assigned, as a reason for this belief, the coincidence between Mr. Le Verrier's results and those of Mr. Adams. He had addressed a letter to Mr. Le Verrier, similar to that sent a year previously to Mr. Adams, to make inquiries about the radius-vector. Mr. Le Verrier answered under date of June 28, stating that the errors of radius-vector must be accounted for, inasmuch as the equations of condition depended on observations at the quadratures as well as at the oppositions. Concerning the correctness of this inference, however, there appears room for discussion. Le Verrier called Airy's attention to the fact, that the position in quadrature in 1844, deduced by means of his formulas from the two oppositions which comprised it, only differed 0".6 from the observed position, which proved, he said, that the error of radius-vector had entirely disappeared. This he considered as one of the strongest arguments in favor of the truth of his results. For, while in his first researches he only made use of oppositions, the quadratures were represented with all precision. "Le rayon vecteur," said he, "s'est trouvé rectifié de lui-même sans que l'on l'eut pris en considération d'une manière directe. Excusez-moi, Monsieur, d'insister sur ce point. C'est une suite du desir que j'ai d'obtenir votre suffrage."

At Airy's suggestion, Professor Challis had already commenced a search for the planet on the 29th July, using a modification of a plan which Mr. Airy had drawn up. The date of the letter suggesting this search was July 9; that of the general plan was July 13. Le Verrier's memoir, which assigned 325° as the probable longitude of the planet, was presented to the French Institute, as we have seen, on June 1st. Still, it does not appear that any search whatever had been instituted in the intervening time in any part of Europe or America; indeed, there is no account of any search having been made excepting by Professor Challis, before the night of September 23.

It must, indeed, be confessed that astronomers in general did not seem to consider the theoretical results published by Mr. Le Verrier as necessarily indicating the *physical* existence and true position of such an exterior planet. Professor Challis alone—the only astronomer who entered into a systematic search for the planet, and the only one excepting Dr. Galle, the assistant at the Royal Observatory of Berlin, whom we know to have even looked for it—has assigned, as a reason which deterred him from an earlier search, that it was "so novel a thing to undertake observations in reliance upon merely theoretical deductions; and that, while much labor was certain, success appeared very doubtful." . . .

The Discovery

A strange contrast to this apathy on the part of other astronomers is furnished by the demeanor of Le Verrier himself. Having fairly arrived at his results, he looked upon them as conclusive. His computations had been an earnest work. He had employed all his analytical powers, and employed them, too, most successfully—to refine the methods which he used, and to narrow the field of his inquiry; all his powers of application and numerical research, to insure precision; and his indomitable perseverance, in carrying out his computations with full vigor, permitted him to omit no possible test of their accuracy. He proved that the observations of Uranus made it necessary to assume the existence of some unknown disturbing body. For the observations which he adopted as the basis of his calculations, he had assigned, *a priori*, the limits of error allowable; and he found that all the observations could be satisfied within these predetermined limits by the assumption of an exterior planet, moving in a given orbit, and having a given mass. The correctness of his results was dependent upon no empirical assumption. He gave them, therefore, fearlessly to the world, and staked his reputation upon their accuracy. This forms by no means the least part of his claims to the respect and admiration of scientists throughout the world. Had the planet not been found in the predicted place, Le Verrier would alone have borne the mortification. Neptune was discovered in almost precisely the direction assigned, and Le Verrier receives the admiration so justly due him.

The mass and orbit given in the memoir of August 31st are as follows:

Semiaxis major	36.1539
Sidereal period	217 yrs. .387
Eccentricity	0.10761
Equation of the center	7° 44′ 44″
Longitude of perihelion, January 1, 1800	284 5 48
Mean longitude	240 17 41
Precession in 47 years	0 39 20
Mean sidereal motion in 47 years	77 50 3
Mean anomaly, 1847, January 1	34 1 56
Mean longitude	318 47 4
Mass	$\frac{1}{9322}$

The geocentric longitude, resulting from this orbit, for the end of September, 1846, was 325°. Le Verrier, in acknowledging the receipt of a memoir, made use of the opportunity thus afforded, to request Dr. Galle to look for the planet. The letter reached Berlin on the 23d September, and Galle, in complying with this request, found, on the same evening, a new planet in longitude 325° 53′, or within 55′ of the geocentric place assigned by Mr. Le Verrier.

FIRST GLANCES AT NEW BOOKS

THE INSECTS OF AUSTRALIA AND NEW ZEALAND—R. J. Tillyard—*Angus and Robertson* (£2 2s). Australia and New Zealand have been the vertebrate zoologist's wonder of the world for generations, but we of the northern hemisphere have known little of the insects of the lands "down under". The monumental work of Dr. Tillyard now makes this knowledge conveniently available. The insects of the antipodes run through the familiar orders, but even in genera whose names are familiar to us we find species whose aspect is as bizarre as that of a wallaby or a wombat. The problems of phylogeny and distributional history that lie behind some of these forms are nothing less than fascinating. No entomologist who sees this book will be contented until he has had a chance to swing his net in Australia and New Zealand.

Entomology
Science News-Letter, August 3, 1929

THE PLANT RUSTS—J. C. Arthur—*Wiley* ($6.50). The biology of the rusts has long been presented in only the sketchiest fashion, not merely in courses in general botany but even in many classes in phytopathology. This has been due at least partly to the fact that the pertinent facts have been scattered through a vast literature. The author of this book and his collaborators have placed plant students of all ranks in their debt by compressing into one wieldy volume the essential facts about the history of their science, the biology of the rusts, their classification and distribution, technique for study, and various other pertinent subjects. It becomes another "automatic necessity" for the botanical bookshelf.

Botany
Science News-Letter, August 3, 1929

MANUAL OF THE VERTEBRATE ANIMALS—David Starr Jordan—*World Book Co.* ($4). This pioneer work of one of America's greatest zoologists now appears in its thirteenth revised edition—evidence enough of the popularity and confidence it has enjoyed for many years. Since 1876, when the first edition appeared, this book has been the zoological equivalent of Gray's Manual of Botany, the *vademecum* of the field naturalist in the northeastern quarter of the United States.

Zoology
Science News-Letter, August 3, 1929

MEAT THROUGH THE MICROSCOPE—C. R. Moulton—*Univ. of Chicago Press* ($5). Our daily meat has become a much more complicated problem than it was in the days of our grandfathers, when it was the concern of the butcher and the buyer, and of no one else beside. Now, with vast-scale packing, greater economy in use, and hundred per cent. salvage of byproducts, all the resources of chemical and biological science are called upon by the meat technologist. Dr. Moulton's book will be useful, both to those who deal in meats in any way, and to those who merely wish to have an intelligent knowledge of what lies beyond their neighborhood butcher's block.

Applied Science
Science News-Letter, August 3, 1929

A MANUAL OF EXTERNAL PARASITES—H. E. Ewing—*Thomas* ($4.50). Making one's life work the study of mites, ticks, lice, fleas and other crawling, sucking, biting arachnids and insects sounds like an itchy and ungrateful sort of a job; but that is what the genial Dr. Ewing has done, and the world owes him gratitude for it. The debt is increased by this his most recent work, wherein he not only condenses the essential taxonomic facts about external parasites, but gives practical suggestions on the best methods of combating them.

Entomology
Science News-Letter, August 3, 1929

THE BOYS' BOOK OF SALVAGE—David Masters—*Dodd, Mead* ($2). From the dredging up of doubloons from a 300-year-old wreck of an Armada galleon to the scrapping of the German fleet, tales of the struggle of men to keep the work of their hands out of Davy Jones' locker are told here in a style that will interest boys of all ages, even those who put on their first "long pants" fifty years or more ago.

Adventure
Science News-Letter, August 3, 1929

THE FISHES OF THE CRANBERRY LAKE REGION—W. C. Kendall and W. A. Dence; and THE STORY OF KING'S POND—F. A. Lucas—*Roosevelt Wild Life Bulletin* ($1). Studies of interesting fisheries situations in New York State.

Ichthyology
Science News-Letter, August 3, 1929

THE NORTH AMERICAN SPECIES OF PASPALUM—Agnes Chase—*Smithsonian Inst.* (free). Mrs. Chase has performed a notable service to agrostologists and to botanists generally by monographing this large and important grass genus. Her name as author is sufficient guarantee of thoroughness and reliability. The many clear-cut text illustrations will be a great help to non-specialists, the more so since a large proportion of them are from type specimens.

Botany
Science News-Letter, August 3, 1929

ABSTRACTS OF THESES: SCIENCE SERIES, VOL. VI, 1927-1928—*Univ. of Chicago* ($3). The practice of the University of Chicago in gathering into an annual volume abstracts of theses submitted by candidates for the Ph. D. degree is much to be recommended.

General Science
Science News-Letter, August 3, 1929

LECTURES ON PLANT PATHOLOGY AND PHYSIOLOGY IN RELATION TO MAN—*Saunders* ($2.50). A series of lectures given at the Mayo Foundation and the Universities of Minnesota, Iowa and Wisconsin, the Des Moines Academy of Medicine, and Iowa State College.

Biology
Science News-Letter, August 3, 1929

I. SUPPLEMENT TO THE FLORA OF BARRO COLORADO ISLAND, PANAMA—L. A. Kenoyer and P. C. Standley, and II. TWO NEW SPECIES OF CHARA FROM TROPICAL AMERICA—M. A. Howe—*Field Mus.* Of interest to students of the taxonomy of tropical plants.

Botany
Science News-Letter, August 3, 1929

A WORKBOOK FOR STUDENTS IN POULTRY HUSBANDRY—W. A. Broyles and A. D. Wilson—*Ginn* (80c). A notebook for use in the classroom and among the pens.

Poultry Husbandry
Science News-Letter, August 3, 1929

THE RED SQUIRREL: ITS LIFE HISTORY AND HABITS—R. T. Hatt—*N. Y. State Coll. of Forestry.* A bulletin of the Roosevelt Wild Life Forest Experiment Station, very useful in that it gets into one place a lot of data about an interesting animal hitherto scattered through the literature or not in print at all.

Zoology
Science News-Letter, August 3, 1929

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